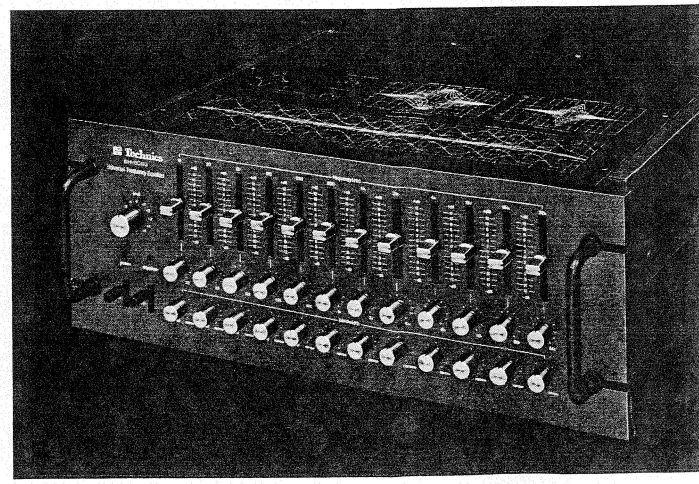
National **Technics**

UNIVERSAL FREQUENCY EQUALIZER

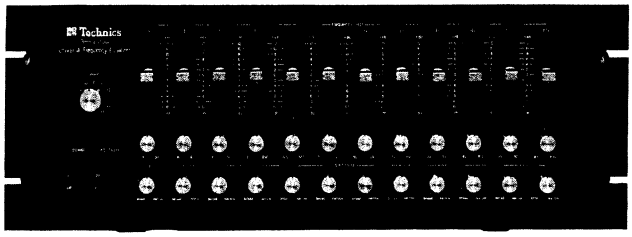
SH-9090

OPERATING INSTRUCTIONS



Before operating this set, please read these instructions completely.

Universal Frequency Equalizer **SH-9090**



Thank you for selecting the "Technics" model SH-9090 universal frequency equalizer.
The model SH-9090 is the result of the combined efforts of "Technics" engineers who have devoted many long years of research to improving the efficiency and sound reproduction of audio equipment.
Only the highest quality products have been used for even the smallest components, and each unit is designed so as to assure maximum reliability and high quality performance.
In order to assure that you will receive maximum benefit from the many features of this unit, we urge you carefully read and follow the operating instructions in this booklet.

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HELPFUL HINTS

1. Keep this unit away from electrical noise-generating devices such as motors and fluorescent lamps.
2. The set should not be exposed to direct sunlight and should be kept free from dust, moisture and vibration.
3. The cabinet of your set should be given the same care which you would give any piece of fine furniture. The front panel should be cleaned with a soft cloth moistened with a mild soap-and-water solution.
   NEVER USE A SOLUTION CONTAINING BENZOL OR PETROLEUM.

Model SH-9090 is designed for monaural use; for stereo use, two units are necessary.

STAR FEATURES

Model SH-9090 is a universal frequency equalizer. This unit has been designed to be used for compensation of the frequency response of microphones, phonograph cartridges, recording tape, amplifiers, speakers, etc., and for overall adjustment of the tone quality of audio systems.
This unit can be used not only for compensation of the frequency response within the audible range, but also, in consideration of the frequency response and resonance frequency of CD-4 cartridges and tone arms, for frequency response compensation within a much wider range, from 5 Hz to 64 kHz.
Because the range from 5 Hz to 64 kHz is divided into 12 separate parts, and each of these parts includes an active filter constructed of only capacitors, resistors and transistors (with no coil), independent control of the frequency response is possible for each of the separate range divisions.

■ Newly developed active filter constructed of only capacitors, resistors and transistors (with no coil) is used for each division of the range

The filters used in this unit are the double-integrating type of filter, and were developed after making extensive use of analog computer technology. Compared with conventional filters which use coils, this new type has outstandingly high performance with respect to the signal-to-noise ratio and with respect to distortion.
And, although continuous variation of the resonance frequency and of the resonance peak Q were impossible with conventional filters which use coils, such continuous variation is now possible through the use of active filters.

■ Continuous variation of the resonance frequency and of the resonance peak Q

Because the resonance frequency and the resonance peak Q were each individually fixed, and therefore could not be varied, with a conventional frequency equalizer, it was previously impossible to make the frequency response and the resonance peak characteristic coincide in order to, for example, compensate for the peaks and dips of the frequency response of a microphone, phono cartridge or speaker system, and thus it was impossible to obtain satisfactory results.
With this unit, the resonance frequency can be varied continuously within a range of 2 octaves, and the resonance peak Q can also be varied continuously between 0.7 and 7. This is, therefore, an outstanding system which permits the user to finally realize the long-sought-after goal of creation of the desired frequency response as well as perfect control of the frequency response of the system.
It can be used widely in various kinds of acoustic systems: not only for dedicated audio enthusiasts who want to use it for adjustment of tone quality during recording and playback, but also by professional users, who will find it ideal for compensation of the frequency response during record disc cutting or while recording master tapes, as well as for such uses as compensation of the acoustic characteristic of listening rooms and concert halls.
In addition, determination of the response frequency and the resonance peak Q was made only after completion of deep logical analysis and careful consideration of measurement results obtained by audio tests.

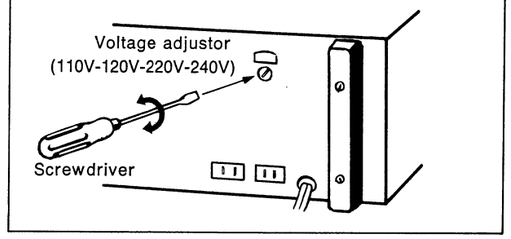
CONNECTIONS AND OPERATION

Do not connect the power plug until all other connections are completely finished.

Voltage adjustment

Make sure that the voltage adjustment screw indicates your correct local voltage.
CAUTION: Be sure to make the voltage adjustment screw setting before connecting the AC power cord.

Figure 1



Input terminal [INPUT]

Connect this terminal with one output terminal ["OUTPUT"] of the pre-amplifier by using the shielded connection wire (included).
The input sensitivity of this input terminal is 1 V, and the input impedance is 50 kΩ.

Output terminals [OUTPUT]

Connect one of these terminals with the input terminal ["INPUT"] of the power amplifier by using the shielded connection wire (included).
The rated output of each output terminal is 1 V, maximum output is 7 V, and output impedance is 500Ω.
Because this unit has two output terminals, connection with two power amplifiers is possible.

AC OUTLETS

"Switched"
Other equipment connected to this outlet can be switched on and off with the power switch on the front panel.
Use this as a power source for other audio equipment.
The capacity is 200W.
"Unswitched"
Any equipment connected to this outlet is always on regardless of the position of the power switch on the front panel.
The capacity is 200W.

CONNECTION WIRING FOR A STEREO SYSTEM

Model SH-9090 is designed for monaural use; for stereo use, two units are necessary.

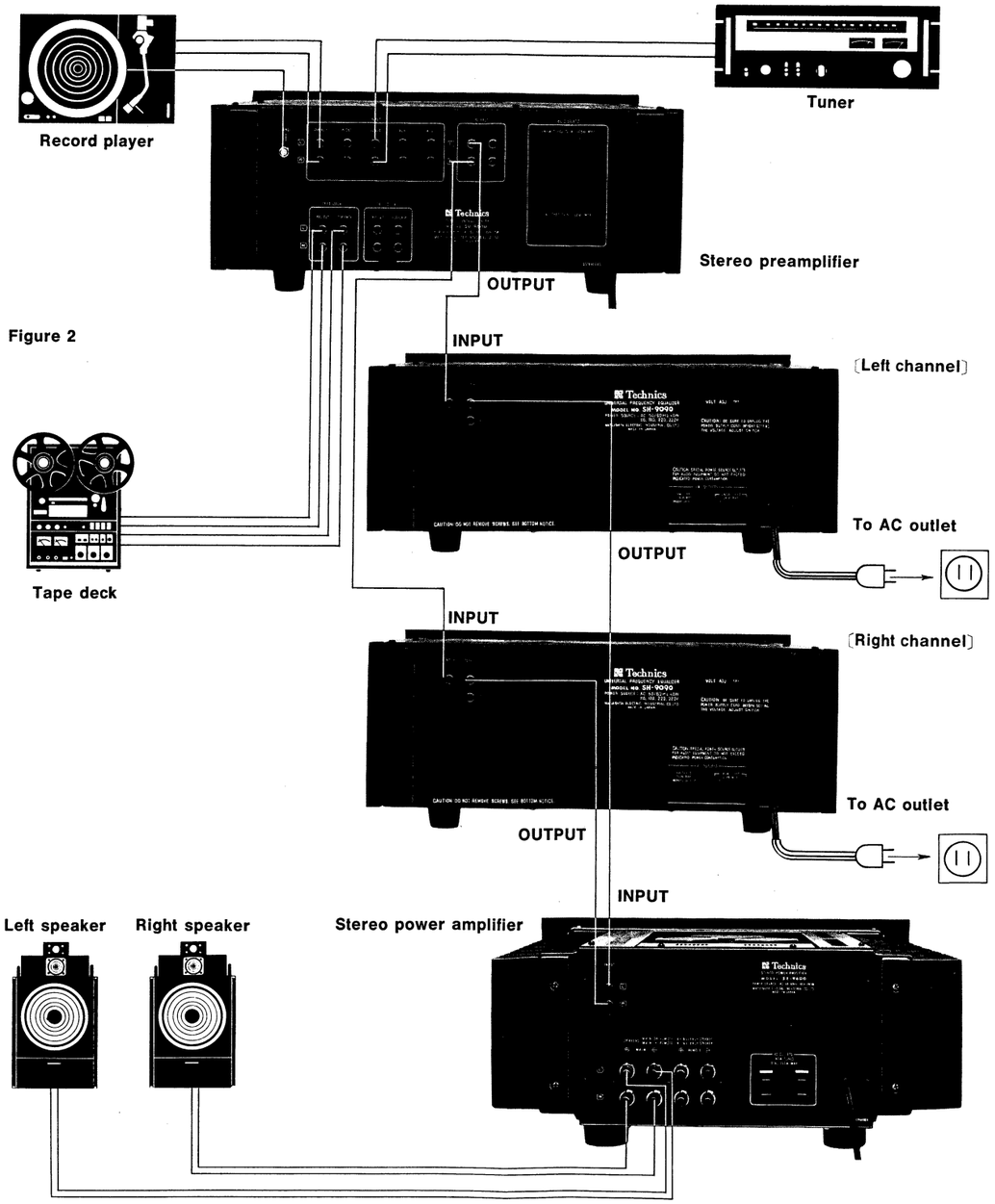


Figure 2

CONTROLS AND THEIR FUNCTIONS

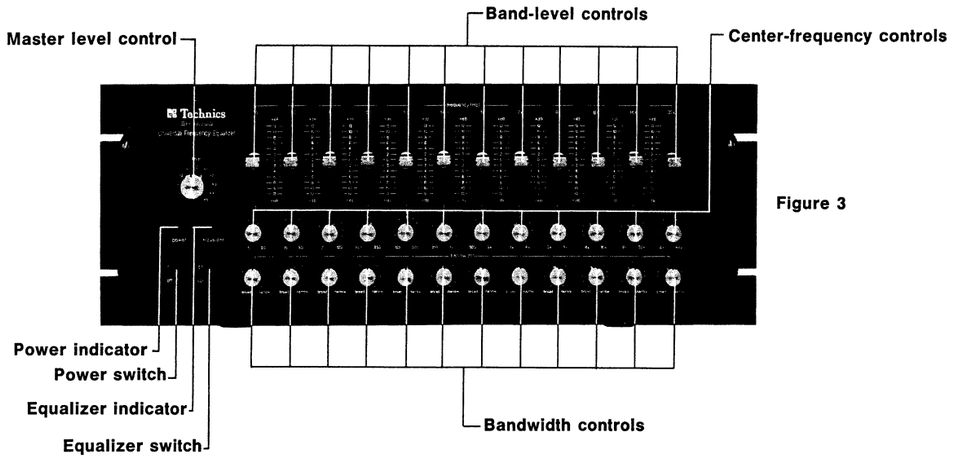


Figure 3

Power switch [power]
This switch is used to turn the power on and off.

Power indicator
When the power switch is turned on, this indicator illuminates to indicate that the unit is in operation. This indicator remains illuminated during operation.

Equalizer switch [equalizer]
This switch turns the equalizer circuit on and off. If the switch is set to the "OUT" position, input signals are sent directly to the output terminal, without passing through the frequency equalizer circuitry. When this switch is set to the "OUT" position, any of the controls can be set to any position without effecting the signals.

Set to the "IN" position for control of the frequency response. The efficiency of this unit can be easily checked by changing this switch back and forth between "IN" and "OUT."

Equalizer indicator
This indicator will illuminate when the equalizer switch is set to the "IN" position.

Master level control [level]
This control can be used to continuously vary the output level of the output terminal within a range from −6 dB to +6 dB.
The output level is decreased by turning the control to the left from the "0" position, and is increased by turning it to the right.

Frequency response

Center-frequency controls: center position
Bandwidth controls: center position

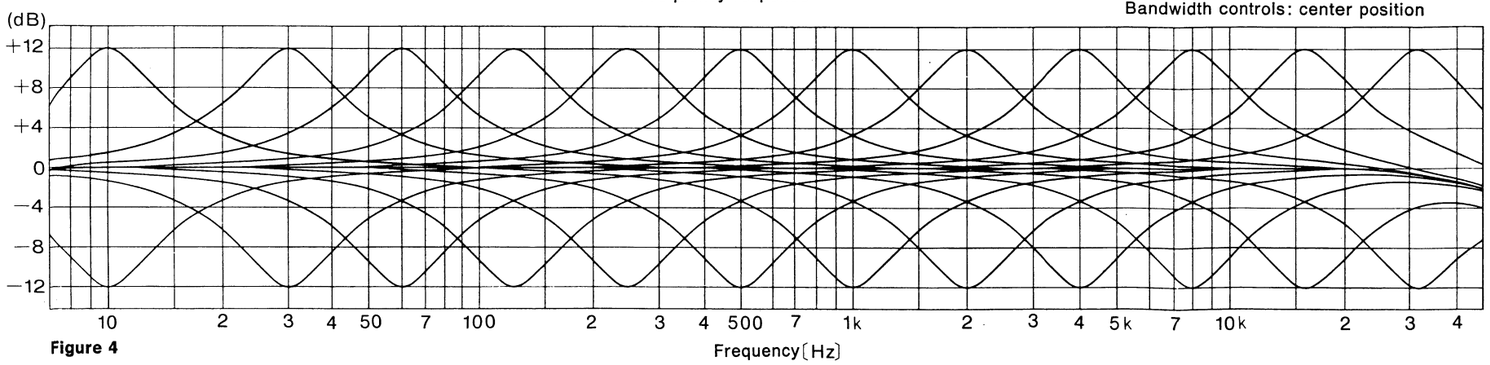
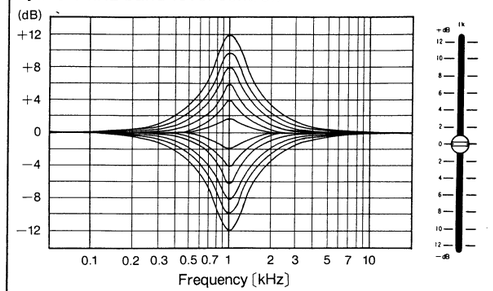


Figure 4

Control of the frequency response
Frequency response can be adjusted by using the 12 band-level controls, one for each band, the 12 center-frequency controls, and the 12 bandwidth controls. The maximum adjustment is from 5 Hz to 64 kHz (corresponding to a range of ±12 dB in which the band level is variable).
The standard frequency for each of the 12 divisions is: 10 Hz, 30 Hz, 60 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 16 kHz and 32 kHz. One band-level control, one center-frequency control, and one bandwidth control are assigned to each division, and variations are possible within a range of +12 dB to −12 dB (for each band-level control), one octave above and below the standard frequency (for each center-frequency control), and, of "Q", from 0.7 to 7 (the sharpness of the peak and dip).
The function of each control is explained below. Although the frequency range differs for each division, the actual operation of the controls for all 12 divisions is the same.

Band-level controls
These controls can be used for continuously varying the level of each frequency response from +12 dB to −12 dB. Figure 5 shows the curve which indicates the variable frequency response when the 1-kHz band-level control is operated.
The other 11 band-level controls can be used to form the same type of curve.

Figure 5 Variations of the frequency response, as caused by the 1-kHz band-level control.



Center-frequency controls
These controls can be used for continuously varying the center frequency of the peak and dip frequency response one octave upward and one octave downward with respect to the indicated standard frequency.
A variable range of one octave upward and downward means a range of 1/2 to 2 times the indicated standard frequency. For example, for the 1-kHz center-frequency control, continuous variation is possible within a range of 500 Hz to 2 kHz. The center frequency becomes lower when this control is turned to the left, and the center frequency becomes 1/2 of the indicated standard frequency by turning it completely to the left.
The center frequency becomes higher when this control is turned to the right, and becomes 2 times the indicated standard frequency by turning it all the way to the right.
(The indicated standard frequencies are 10 Hz, 30 Hz, ~ 16 kHz and 32 kHz, as indicated on the front panel.)
Figure 6 shows the curve which indicates the variable frequency response when the 1-kHz center-frequency control is operated.

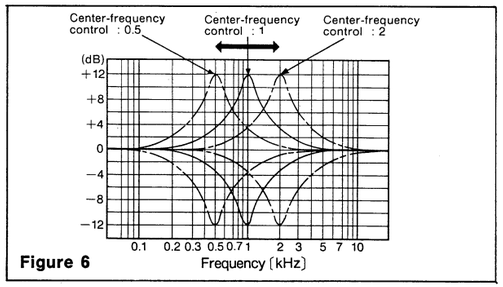
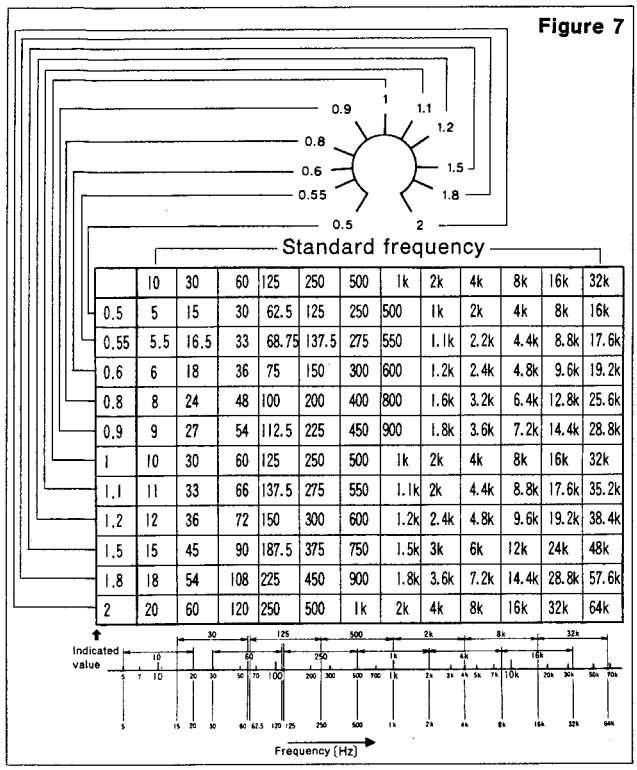


Figure 6

Figure 7 shows the relationship between (1) the value indicated on the control and (2) the center frequency. The center frequency can be obtained by multiplying [the indicated standard frequency of the control which is used] times [the value shown in figure 7].
For example, if the indication of the 1-kHz center-frequency control is 0.6, the center frequency is 600 Hz.

Figure 7



	10	30	60	125	250	500	1k	2k	4k	8k	16k	32k
0.5	5	15	30	62.5	125	250	500	1k	2k	4k	8k	16k
0.55	5.5	16.5	33	68.75	137.5	275	550	1.1k	2.2k	4.4k	8.8k	17.6k
0.6	6	18	36	75	150	300	600	1.2k	2.4k	4.8k	9.6k	19.2k
0.8	8	24	48	100	200	400	800	1.6k	3.2k	6.4k	12.8k	25.6k
0.9	9	27	54	112.5	225	450	900	1.8k	3.6k	7.2k	14.4k	28.8k
1	10	30	60	125	250	500	1k	2k	4k	8k	16k	32k
1.1	11	33	66	137.5	275	550	1.1k	2k	4.4k	8.8k	17.6k	35.2k
1.2	12	36	72	150	300	600	1.2k	2.4k	4.8k	9.6k	19.2k	38.4k
1.5	15	45	90	187.5	375	750	1.5k	3k	6k	12k	24k	48k
1.8	18	54	108	225	450	900	1.8k	3.6k	7.2k	14.4k	28.8k	57.6k
2	20	60	120	250	500	1k	2k	4k	8k	16k	32k	64k

Bandwidth controls [bandwidth (Q)]

These controls can be used for continuously varying the sharpness of the peak and the dip of the frequency response.

The "Q" is one of the measuring methods used for expressing the sharpness of the peak and the dip.

As you can understand from the foregoing explanation, the sharper the peak and the dip, the higher the value of "Q." These controls can be used to continuously vary the value of "Q," based on the definition given below, from 0.7 through 7.

The value of "Q" is 2 when the indication mark on the control is set to the center position, and the value becomes smaller (peak and dip less sharp) when the control is turned to the left. The value of "Q" becomes 0.7 at the "BROAD" position (when the control is turned completely to the left).

The value of "Q" becomes larger (peak and dip become sharper) when the control is turned to the right, increasing to 7 at the "NARROW" position (when the control is turned completely to the right).

Figure 8 shows the curve which indicates the variable frequency response when the 1-kHz bandwidth control is operated, and the relationship between (1) the value indicated on the control and (2) the "Q" value.

Figure 8 Variations of frequency response, as caused by the bandwidth control.

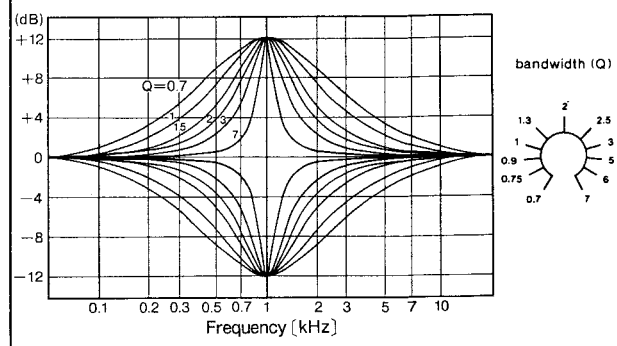
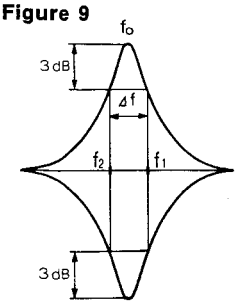


Figure 9



• Definition of "Q"

"Q" expresses the sharpness of the peak and the dip, and its value is expressed as the value obtained when the center frequency (f_o) is decreased by 3 dB less than the peak point (the dip point is increased by 3 dB), and is divided by the frequency range ($\Delta f = f_1 - f_2$).

$$Q = \frac{f_o}{\Delta f}$$

Note: The transfer function of the frequency response of the peak and of the dip of this model is expressed by formula (1).

$$T = \frac{\left(\frac{j\omega}{\omega_o}\right)^2 + \frac{1}{Q_2}\left(\frac{j\omega}{\omega_o}\right) + 1}{\left(\frac{j\omega}{\omega_o}\right)^2 + \frac{1}{Q_1}\left(\frac{j\omega}{\omega_o}\right) + 1} \quad \cdots\cdots (1)$$

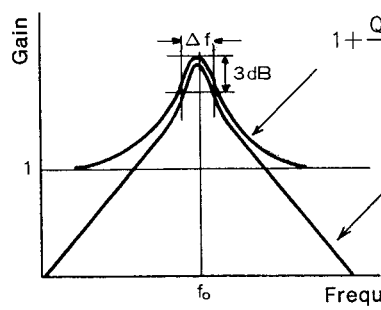
Which, transformed, becomes:

$$T = 1 + \frac{Q_1 - Q_2}{Q_2} \cdot \frac{\frac{1}{Q_1}\left(\frac{j\omega}{\omega_o}\right)}{\left(\frac{j\omega}{\omega_o}\right)^2 + \frac{1}{Q_1}\left(\frac{j\omega}{\omega_o}\right) + 1} \quad \cdots\cdots (2)$$

This response is shown in the figure below.

Here, when $\frac{Q_1 - Q_2}{Q_2}$ is sufficiently greater than (1), a sharpness of the resonance peak can be expressed as $Q_1 = \frac{f_o}{\Delta f}$

For this unit, this Q_1 is used to express sharpness.



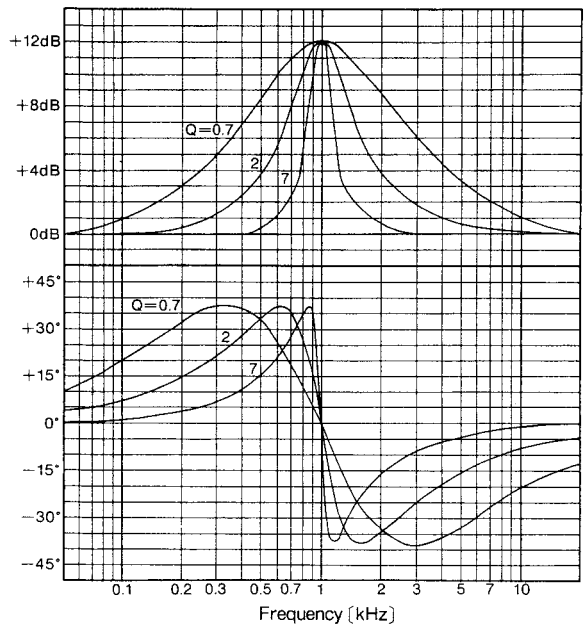
$$1 + \frac{Q_1 - Q_2}{Q_2} \cdot \frac{\frac{1}{Q_1}\left(\frac{j\omega}{\omega_o}\right)}{\left(\frac{j\omega}{\omega_o}\right)^2 + \frac{1}{Q_1}\left(\frac{j\omega}{\omega_o}\right) + 1}$$

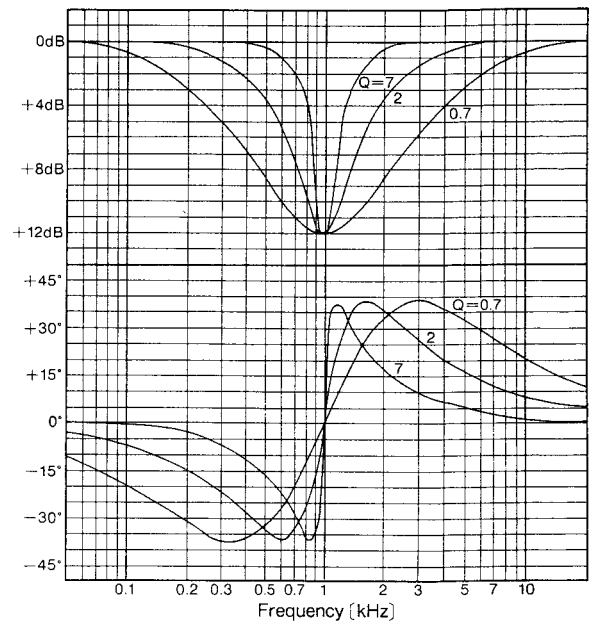
$$\frac{Q_1 - Q_2}{Q_2} \cdot \frac{\frac{1}{Q_1}\left(\frac{j\omega}{\omega_o}\right)}{\left(\frac{j\omega}{\omega_o}\right)^2 + \frac{1}{Q_1}\left(\frac{j\omega}{\omega_o}\right) + 1}$$

THE PHASE CHARACTERISTIC

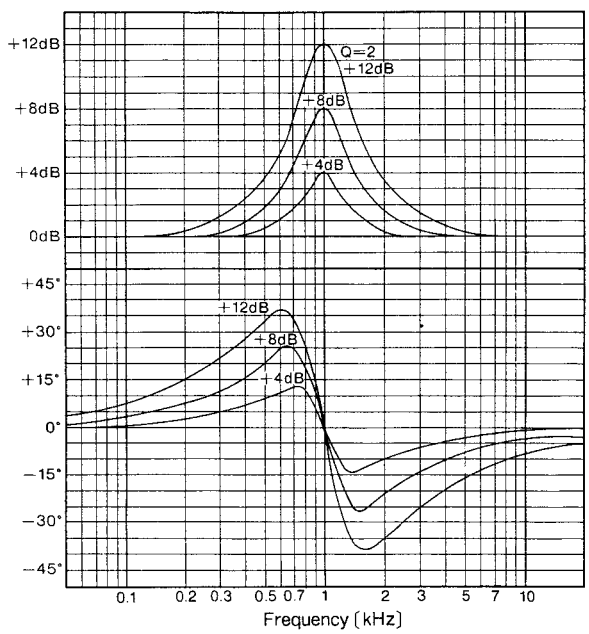
The relationship between the frequency response and the phase characteristic is shown in the figure below.

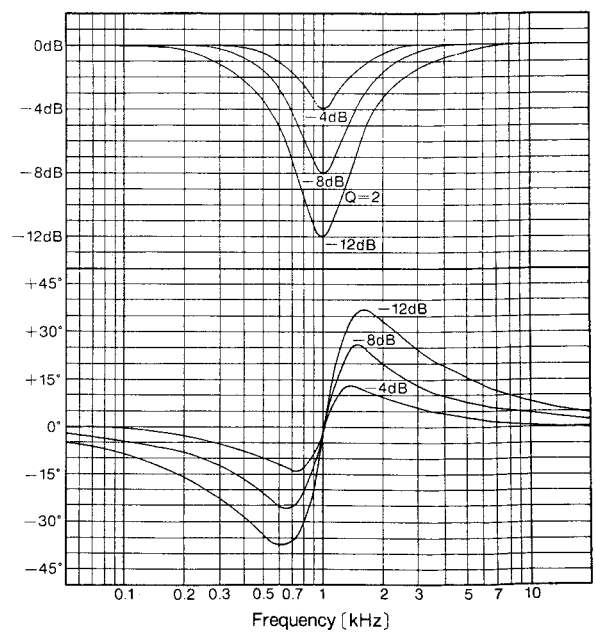
When the setting of a bandwidth control is changed.





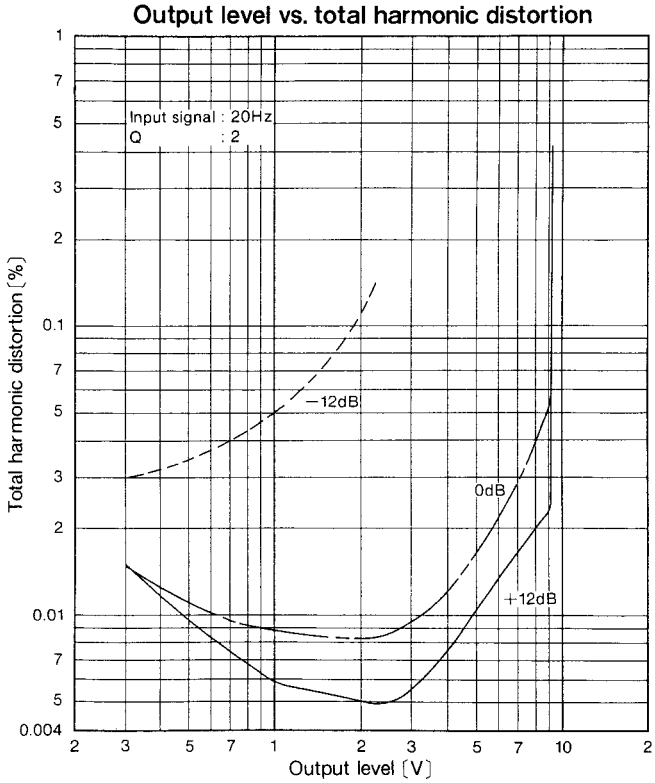
When the setting of a band-level control is changed.



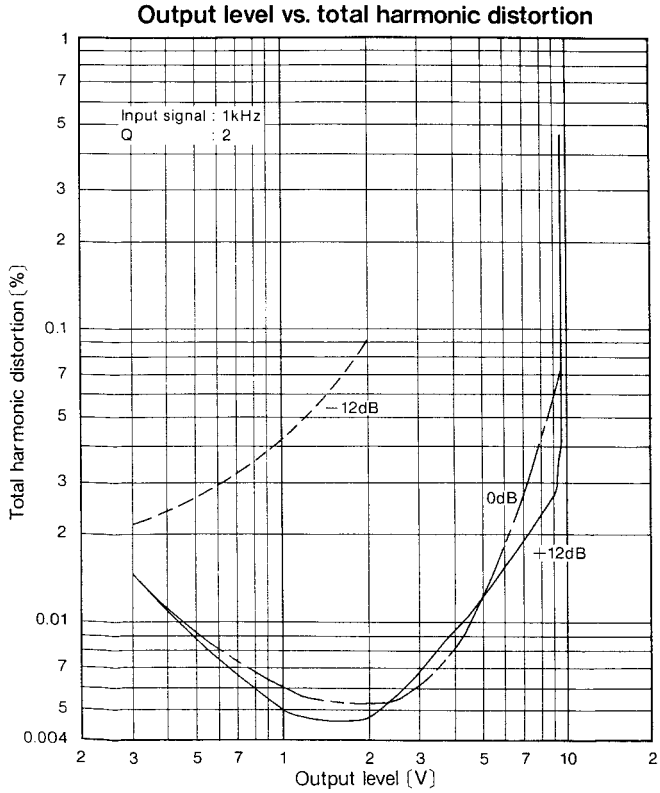


RESPONSE CURVES

Output level vs. total harmonic distortion



Output level vs. total harmonic distortion



TECHNICAL SPECIFICATIONS

Output voltage/output impedance	
Rated (1 kHz)	1V/500Ω
Maximum (1 kHz)	7V/500Ω
Total harmonic distortion	0.05% (rated output)
Input sensitivity/input impedance (1 kHz)	1V/50kΩ
Frequency response	10 Hz~30 kHz, +0 dB −0.5 dB 3 Hz~80 kHz, +0 dB −3 dB
S/N (IHF, A) Signal=1V	90 dB
Master level controls	+6 dB~−6 dB
Band-level controls	+12 dB~− 12 dB (12 divisions)
Center-frequency controls	From 1 octave above to 1 octave below the standard frequency (12 divisions)
Bandwidth controls [Q]	0.7~7 (12 divisions)
Center frequency	10 Hz, 30 Hz, 60 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8kHz, 16 kHz, 32 kHz
Power supply	110V, 120V, 220V, 240V
Power consumption	40W
Dimensions (W x H x D)	450 x 173 x 375 mm 17 23/32" x 6 13/16" x 14 3/4"
Weight	9.2 kg 20.3 lb

Output level vs. total harmonic distortion